National Aeronautics and
Space Administration

Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

Atmospheric Infrared Sounder

Trends in AIRS Engineering Data – Potential Climate Applications

Steve Broberg

April 28, 2011

Calibration and Operations Status
AIRS Science Team Meeting
April 26–28, 2011, Pasadena CA

Overview

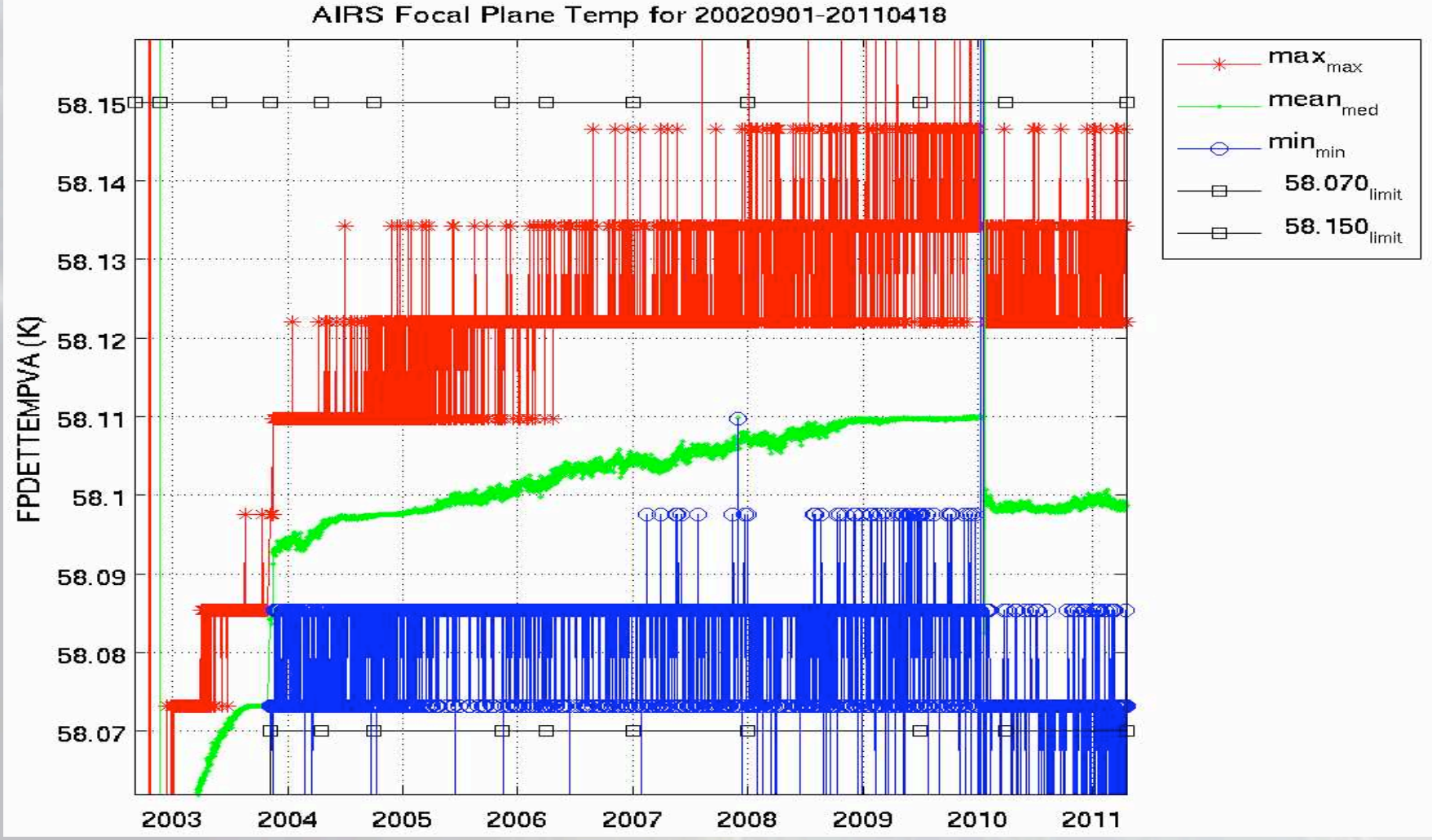
- **Better title might have been: "What data haven't we used to improve the quality of the radiances to levels desired for climate studies"**
- **Measurement goals for climate studies:**
  - ***4mK/year stability, 100mK accuracy for spectrally resolved radiances (Ohring et al. 2005)***
- **AIRS stability better than 10 mK/year (as good as 4 mK/year in RTGSST comps), accuracy ~200 mK**
- **Some data trends/characteristics of interest**
- **Vis response trends**

National Aeronautics and Space Administration

Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

AIRS Focal Plane Temperature

Atmospheric Infrared Sounder

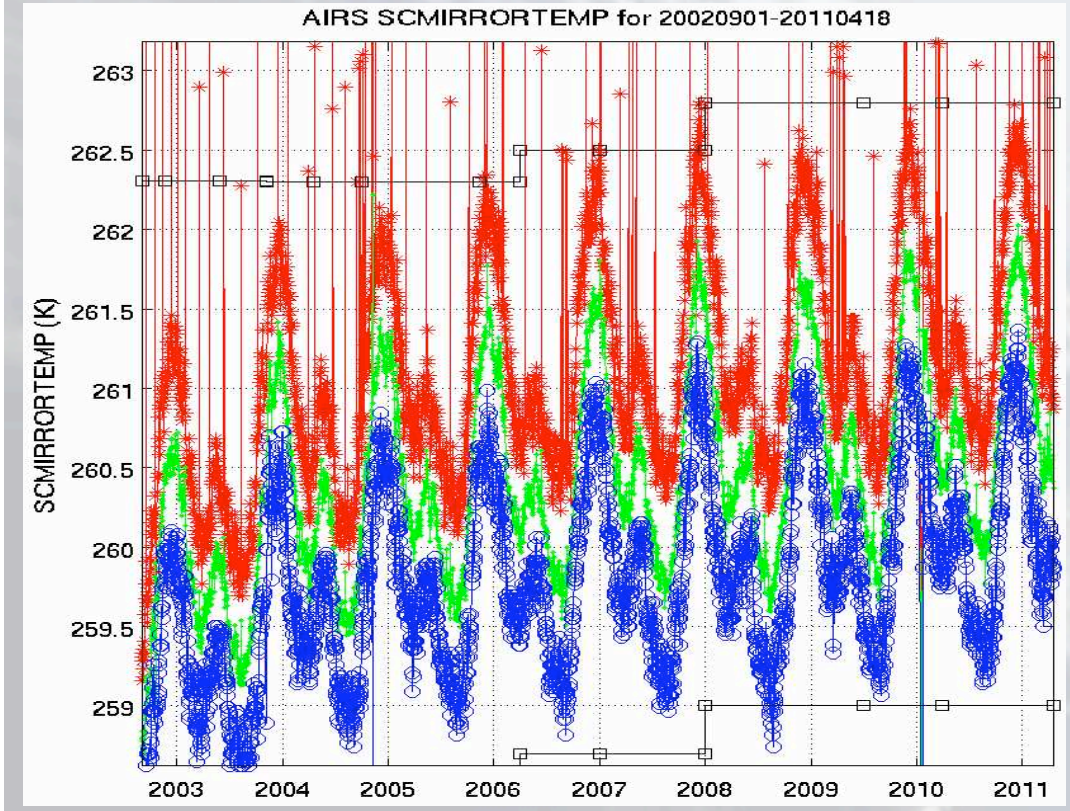


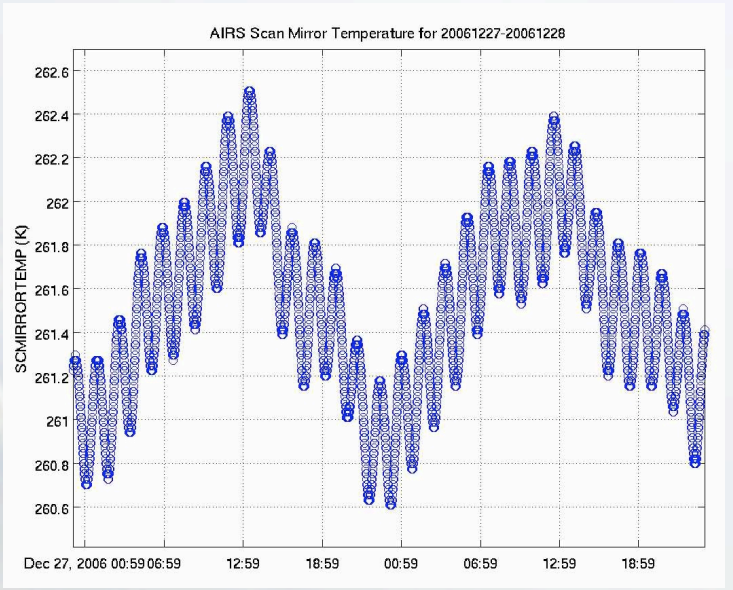
National Aeronautics and Space Administration

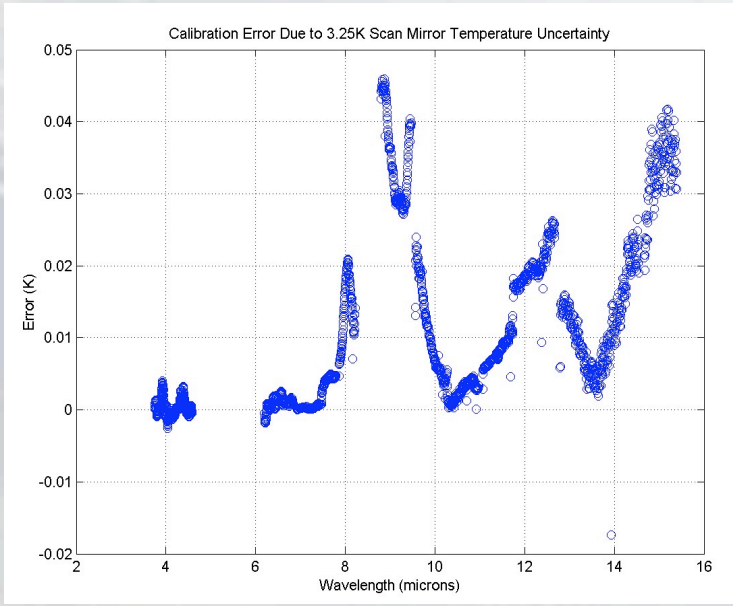
Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

AIRS Scan Mirror Temperature

Atmospheric Infrared Sounder







Thermistor radiatively coupled with mirror – peak to peak response observed less than actual and data out of phase with actual. Early modeling (2004 Pagano) indicated error on the order of 10s of mKs for some channels. Extensive modelling required for correction.

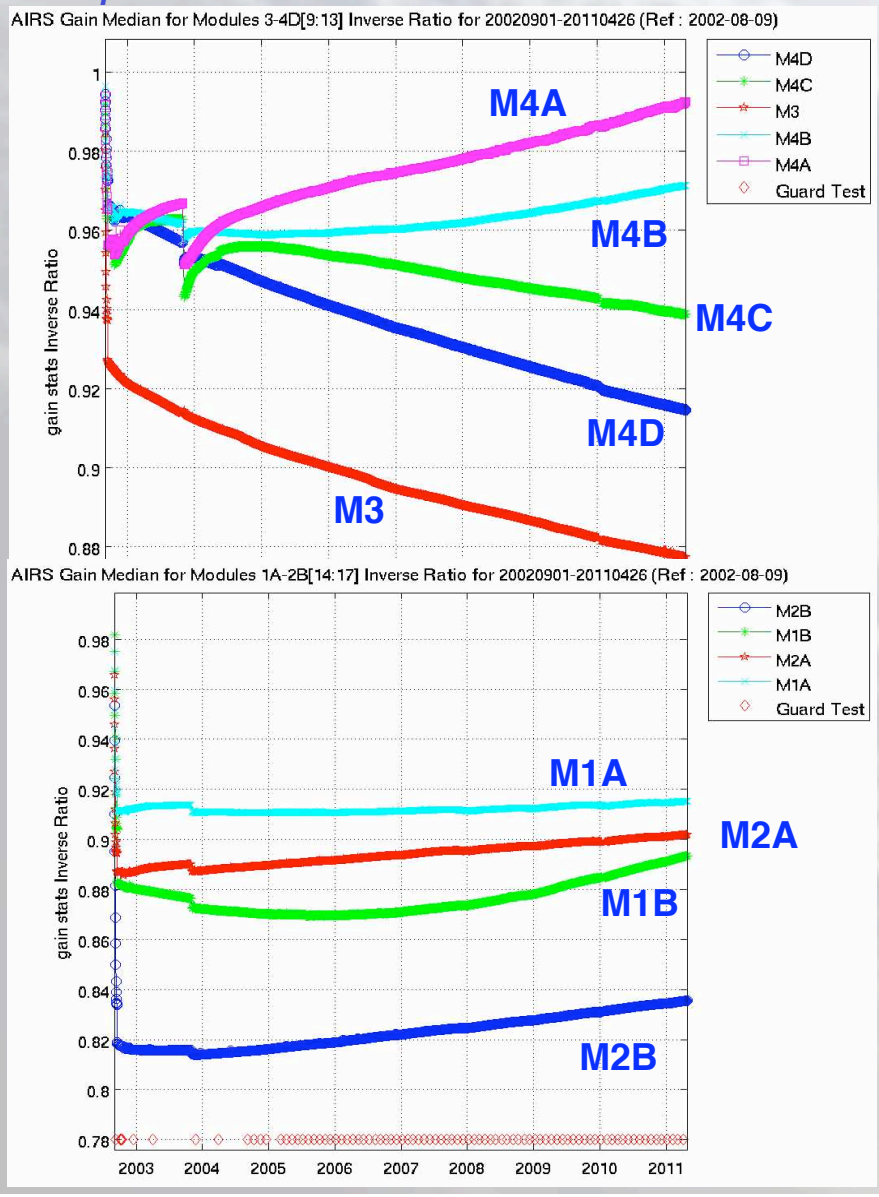
National Aeronautics and Space Administration

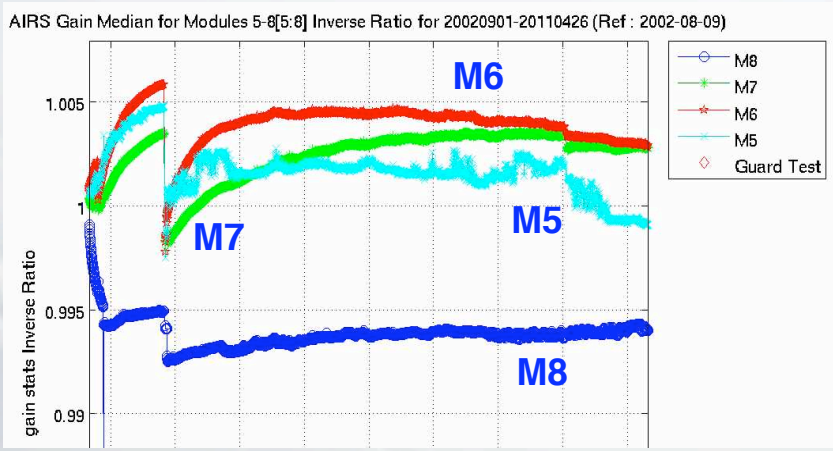
Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

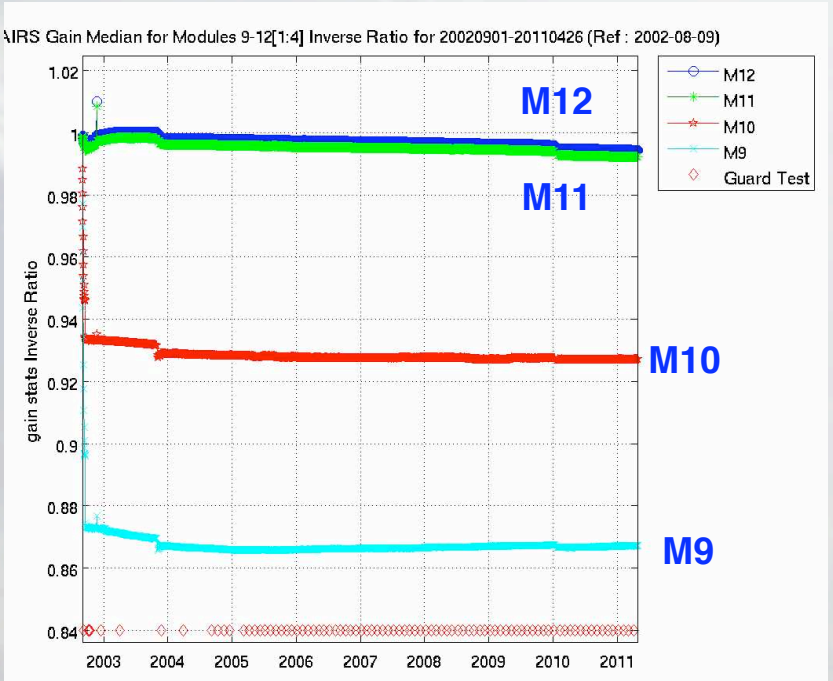
AIRS Gain Trends

Atmospheric Infrared Sounder

To first order, gain variability is removed by calibration.







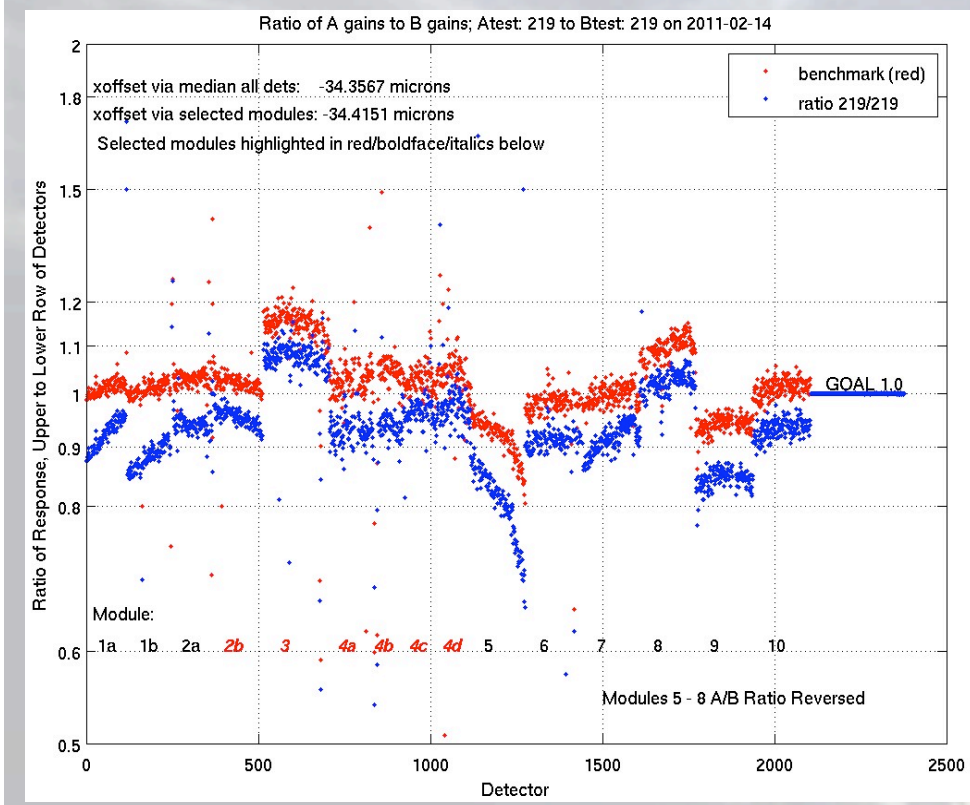
National Aeronautics and Space Administration

Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

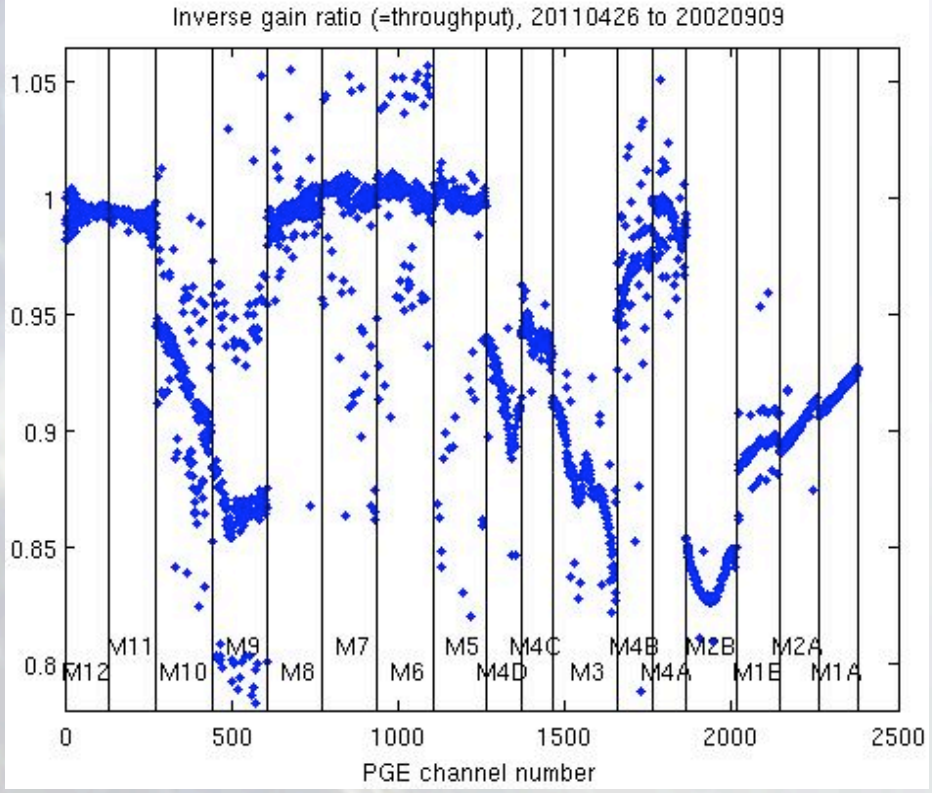
Atmospheric Infrared Sounder

Factors in Gain Variability

Slit position (A/B detector illumination)



Icing/contamination

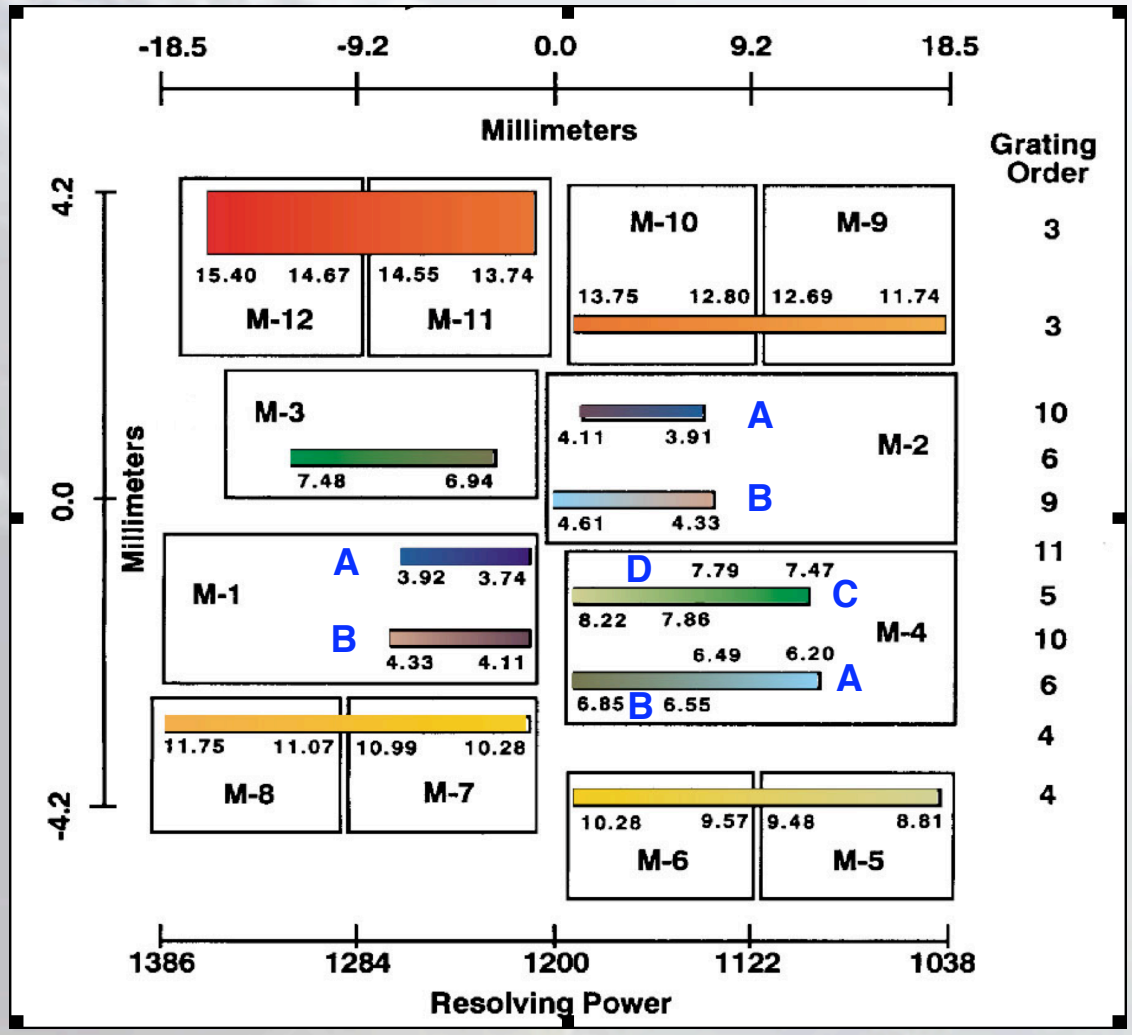


National Aeronautics and Space Administration

Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

Atmospheric Infrared Sounder

AIRS Focal Plane Layout



National Aeronautics and Space Administration

Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

Atmospheric Infrared Sounder

AIRS Detector Characteristics

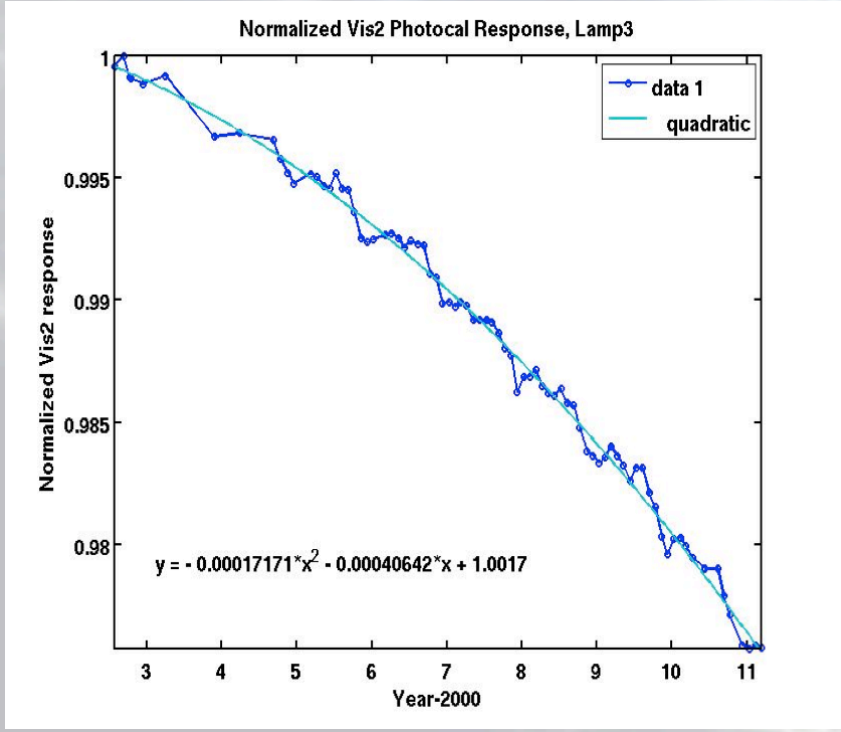
- **Some channels have degraded noise performance due to radiation effects.**
- **Increased noise does not generally affect accuracy for averaged data sets unless noise is non-Gaussian. Some of these channels exhibit non-Gaussian noise.**
- **Review last year indicated 150 channels could be improved by changing weights, but most are Gaussian – update deferred.**
- **Loss of unique CO2 channel (791.7 cm^{-1}) may encourage table update.**

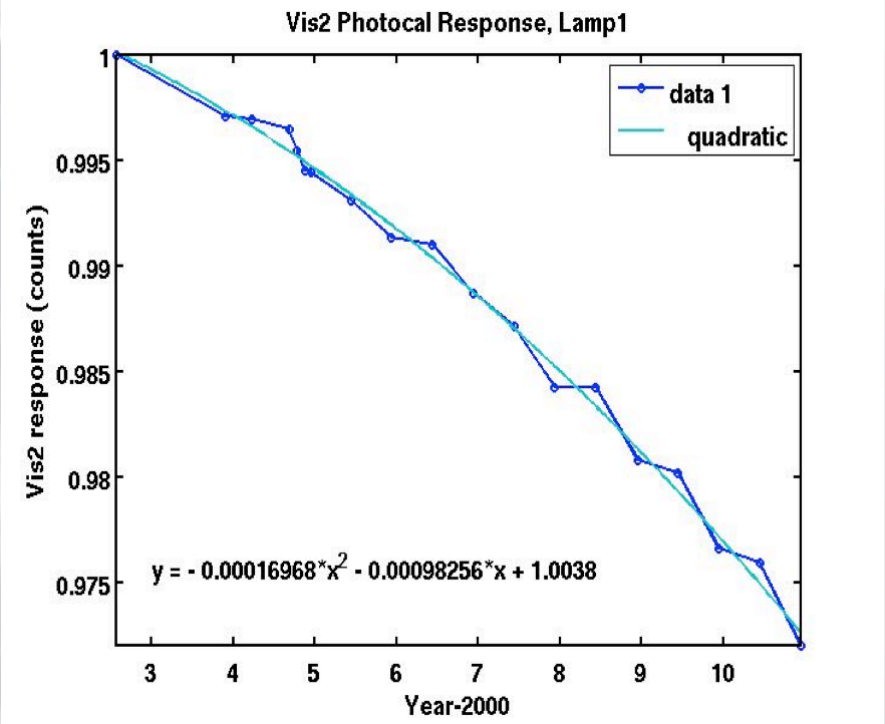
National Aeronautics and Space Administration

Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

Atmospheric Infrared Sounder

Vis 2 (0.58-0.68 μm) photocal response





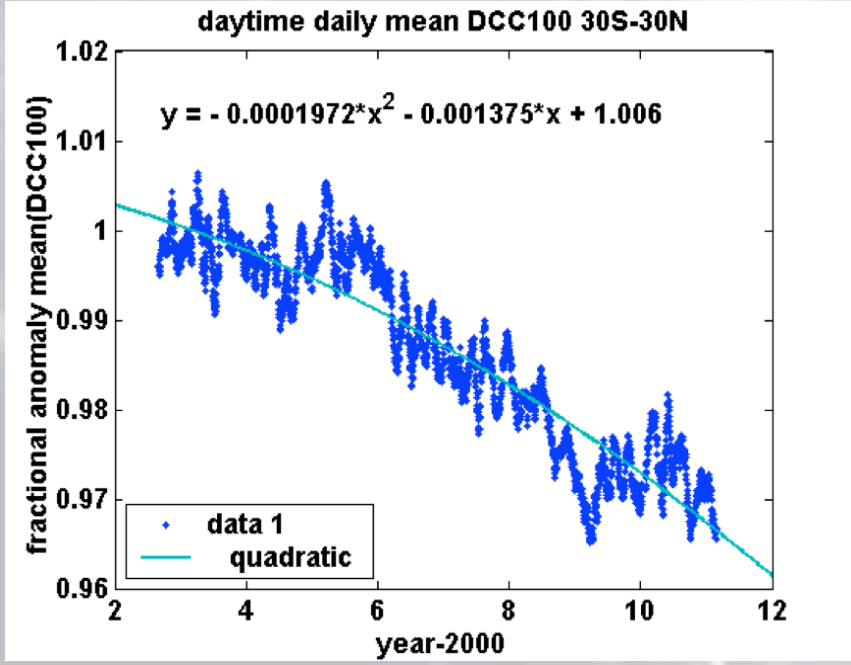
Vis2 decreases at a a rate of -.28%/year for Lamp 3, -.35%/year for Lamp 1
(Lamp 3 used monthly, Lamp 1 2x per year)

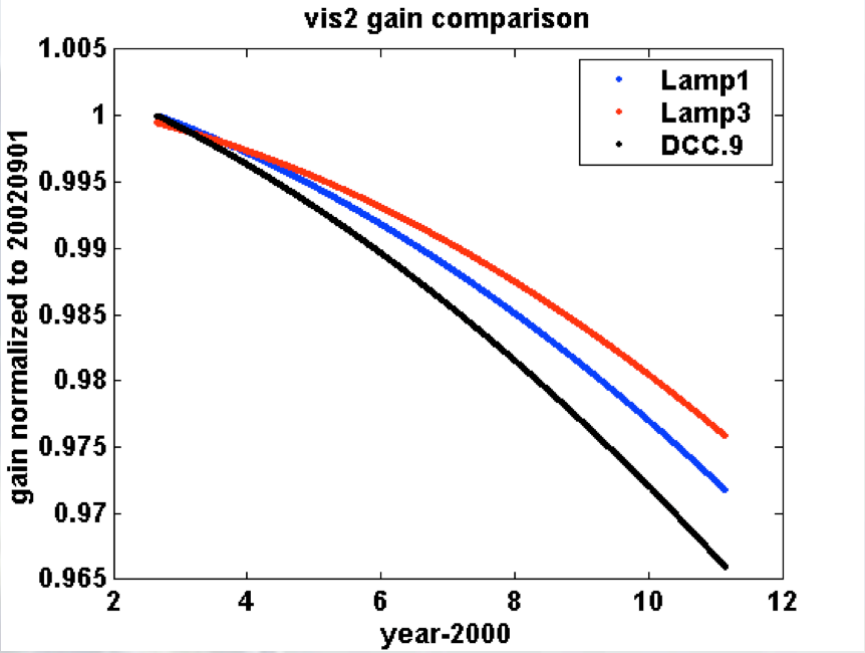
National Aeronautics and Space Administration

Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

Atmospheric Infrared Sounder

Deep Convective Cloud (DCC) response in the vis2 channel





DCC vis2 trend is -0.40 %/year. Using Lamp3 to correct gain, the vis2 signal from the DCC has a trend of -0.1%/year with 0.1%/year (2 sigma) uncertainty .

Climate measurement goals for visible radiometer stability for ocean color studies is 1% per decade or .1% per year (Ohring et al. 2005)

Summary

- **In addition to ongoing efforts to improve the AIRS radiometric performance to better allow climate studies, we should consider instrument diagnostic experiments to be performed:**
  - In the event of a spacecraft or instrument anomaly which results in an instrument warm up
  - At spacecraft/instrument end of mission (should we arrive there in good health)
- **For AIRS, this could involve extended A/B data sets, AMA adjustments, deep space views, etc.**
- **Concepts and procedures should be developed while we still have the appropriate personnel on the project.**